

Having thus described the invention, we hereby claim:

1. An apparatus for adaptively predistorting a base-band signal having an in-phase component and a quadrature component, the signal being generated by a communication device, the apparatus comprising:
- a clipping module operative to clip the base-band signal to produce a  
5 clipped signal;
  - a filter module operative to filter the clipped signal to eliminate high frequency components of the clipped signal and to produce a filtered signal;
  - a sampling module to increase the sampling rate of the filtered signal to obtain an upsampled signal;
  - 10 an index calculating module operative to calculate index values based on the in-phase component and quadrature component of the base-band signal;
  - a look-up table having stored therein parameters, the parameters being retrievable based on the index values;
  - an output module operative to generate an output signal based on the  
15 parameters retrieved from the look-up table and the upsampled signal;
  - a receiver operative to retrieve samples of RF signals generated based on the output signals; and,
  - a processor operative to provide adaptive feedback to the look-up table based on the samples.
2. The apparatus as set forth in claim 1 wherein the up-sampling module increases the sampling rate by a factor of four.
3. The apparatus as set forth in claim 1 wherein the index values are calculated by summing the squares of the inphase component and the quadrature component.
4. The apparatus as set forth in claim 1 wherein the index values are the instantaneous power envelopes of the base-band signals.
5. The apparatus as set forth in claim 1 wherein the parameters are derived from polynomial equations having coefficients.

6. The apparatus as set forth in claim 5 wherein the parameters are defined as A and B and the polynomial equations are as follows:

$$A = C_0 + C_1P + C_2P^2 + C_3P^3 \text{ for } A \leq A_m$$

$$A = A_m \text{ otherwise}$$

5  $B = C_4P + C_5P^2 + C_6P^3 \text{ for } P \leq P_b$

$$B = (B_{b1} - B_{b2}) + C_7P + C_8P^2 + C_9P^3 \text{ for } P > P_b$$

where  $P = (I^2 + Q^2)$  is the instantaneous envelope power,  $A_m$  is a maximum value imposed on A to prevent the amplifier from being driven deep into  
10 saturation,  $P_b$  is a breakpoint where the B parameter transitions from one polynomial equation to the other,  $B_{b1}$  and  $B_{b2}$  are the values of B at  $P = P_b$  using the first and second polynomial, respectively, and  $C_0$  through  $C_9$  are coefficients.

7. The apparatus as set forth in claim 5 wherein the adaptive feedback optimizes the coefficients.

8. The apparatus as set forth in claim 1 further comprising a delay module positioned between the sampling module and the output module.

Sub 100 A method for adaptively predistorting a base-band signal having an in-phase component and a quadrature component, the method comprising:  
generating the base-band signal by a communication device;  
clipping the base-band signal to produce a clipped signal;  
5 filtering the clipped signal to eliminate high frequency components of the clipped signal to produce a filtered signal;  
increasing the sampling rate of the filter signal to obtain an upsampled signal;  
obtaining predistortion parameters;  
10 outputting an output signal based on the predistortion parameters and the upsampled signal;  
sampling RF signals generated based on the output signals; and,  
providing adaptive feedback based on the sampling.

10. The method as set forth in claim 9 wherein the increasing of the sampling rate comprises increasing the sampling rate by a factor of four.

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11. The method as set forth in claim 9 wherein the obtaining of the parameters includes calculating an index value by summing squares of the in-phase component and the quadrature component.

12. The method as set forth in claim 11 wherein the obtaining further comprises retrieving the parameters from a look-up table.

13. The method as set forth in claim 9 further comprises deriving the parameters from polynomial equations having coefficients.

14. The method as set forth in claim 13 wherein the parameters are derived by defining the parameters as A and B and manipulating the polynomial equations as follows:

$$A = C_0 + C_1P + C_2P^2 + C_3P^3 \text{ for } A \leq A_m$$

$$A = A_m \text{ otherwise}$$

$$B = C_4P + C_5P^2 + C_6P^3 \text{ for } P \leq P_b$$

$$B = (B_{b1} - B_{b2}) + C_7P + C_8P^2 + C_9P^3 \text{ for } P > P_b$$

where  $P = (I^2 + Q^2)$  is the instantaneous envelope power,  $A_m$  is a maximum value imposed on A to prevent the amplifier from being driven deep into saturation,  $P_b$  is a breakpoint where the B parameter transitions from one polynomial equation to the other,  $B_{b1}$  and  $B_{b2}$  are the values of B at  $P = P_b$  using the first and second polynomial, respectively, and  $C_0$  through  $C_9$  are coefficients.

15. The method as set forth in claim 9 further comprising delaying input of the up-sampled signal to the output module.

16. A system for adaptively pre-distorting a base-band signal having an in-phase component and a quadrature component, the system comprising:  
means for generating the base-band signal by a communication device;  
means for clipping the base-band signal to produce a clipped signal;  
5 means for filtering the clipped signal to eliminate high frequency components of the clipped signal to produce a filtered signal;  
means for increasing the sampling rate of the filter signal to obtain an up-sampled signal;  
means for calculating an index value based on the in-phase component  
10 and quadrature component;  
means for retrieving parameters from a look-up table, the retrieving being based on the index values;  
means for outputting an output signal based on the parameters retrieved from the look-up table and the up-sampled signal;  
15 means for sampling RF signals generated based on the output signals;  
and,  
means for providing adaptive feedback to the look-up table based on the sampling.

*Sub B4*  
An apparatus for adaptively predistorting a base-band signal, the apparatus comprising:  
a sampling module to increase the sampling rate of the signal to obtain  
an upsampled signal;  
5 a module operative to calculate predistortion parameters;  
an output module operative to generate an output signal based on the predistortion parameters and the upsampled signal;  
a receiver operative to retrieve samples of RF signals generated based on the output signals; and,  
10 a processor operative to provide adaptive feedback based on the samples.

18. The apparatus as set forth in claim 17 further comprising a clipping module operative to clip the baseband signal.

19. The apparatus as set forth in claim 18 further comprising filter module operative to filter the baseband signal after clipping.

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20. The apparatus as set forth in claim 17 wherein the parameters are derived from polynomial equations having coefficients.

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